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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/884,207	06/19/2001	Hiroshi Oinoue	450100-03290	3791

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EXAMINER	
GRAHAM, ANDREW R	
ART UNIT	**PAPER NUMBER**
2644	6

DATE MAILED: 07/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/884,207	OINOUE ET AL.	
	Examiner	Art Unit	
	Andrew Graham	2644	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-5 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-5 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 19 June 2001 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Specification

2. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: "Apparatus for Adjustable Positioning of Virtual Sound Source".

The disclosure is objected to because of the following informalities:

- the word "od" in the final line of page 8 appears as if it should be rewritten as "of".

Applicant's assistance is respectfully requested in correcting any other minor formalities of this nature in the application that are not specifically cited herein.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. **Claims 1-3** are rejected under 35 U.S.C. 103(a) as being unpatentable over Klayman et al (USPN 5850453) in view of Grimani (US 2001/0031054) and Tokumo et al (USPN 4622691). Hereafter, "Klayman et al" will be referred to as "Klayman" and "Tokumo et al" will be referred to as "Tokumo".

Klayman discloses an audio system for a vehicle that corrects and enhances the perception of a stereo audio signal. Figure 2 illustrates the positioning of speakers (46,50) in a vehicle (40) (col. 5, lines 55-60). Figure 4A illustrates a desired frequency response curve (60), wherein the response is flat throughout the range of audible frequencies, which corresponds to a pair of ideal speakers being placed in front of a listener at approximately ear level (col. 6, lines 18-31). In the vehicle, this direction corresponds to sound arriving from the dashboard (55) toward the vehicle occupant (48) (col. 6, lines 32-41). Figures 4B-4D represent actual, non-ideal frequency responses, wherein the various frequency ranges may be errantly positioned above or below the occupant's ear level (col. 7, lines 9-12, 39-42, and 55-62). In the disclosed system, Klayman teaches an image correction circuit (22) with high and low frequency correction circuits for each sound channel (80,82,84,86) for flattening the perceived frequency response of a sound received by an

occupant (col. 8, lines 26-37). Figure 6A-6C show corrected sound outputs, wherein Figure 6B shows one arrangement with particular correction of the higher audible frequency ranges (col. 11, lines 1-3). Figure 9 is a diagram of a circuit used in implementing the image correction circuit. The input signal is first passed through a variable resistor (234) that boosts the level of the overall signal (col. 14, lines 44-50). The low frequency correction and high frequency correction units are implemented with high pass filters (258,260) with differing cutoff frequencies (col. 15, lines 56-67 and col. 16, lines 1-10). The outputs of the filters (258,260) are connected to a pair of variable resistances (282,296) (col. 15, lines 7-13). The response shown in Figure 6B corresponds to setting the resistor (296) of the low frequency correction circuit (260) to zero, which minimizes the signal from the circuit (260) (col. 16, lines 25-38). The signal from the high frequency correction circuit (258) is the main signal thus corrected in such a setting, and the signal can be raised or lowered according to the level of the low frequency ranges (col. 16, lines 39-55). The adjusted signals are then recombined with an original version (252) of the input supplied to the correction circuits (258,260) to form the output signal for the system (col. 16, lines 49-55). In the high frequency decreasing mode, the signal from the high frequency correction circuit (302) is opposite in sign of that of the other two signal components (252,304), which means that the high frequency corrected signal (302) is subtracted from the other two components (252,304) (col. 16, lines 45-55). The corrected

output signals (94,96) are then supplied to a mixer (142) that provides left and right output signals (30,32) that are applied to speakers (46,50) such as those illustrated for the automobile (40) (col. 9, lines 66-67 and col. 10, lines 1-4). The overall device reads on "An acoustic apparatus". The pair of variable resistances (282,296) for each channel read on "attenuator means for attenuating a first audio signal supplied thereto to produce a second audio signal". The illustrated speakers (46,50) connected to the output of the image correction circuit (22) through the mixer (142) read on "speaker means supplied with the fourth audio signal". The desired positioning of the virtual speaker source (A), in view of the applied image correction values, reads on "attenuation of the first audio signal in the attenuator means is so selected that listener who intends to listen to reproduced sound obtained from the speaker means is able to recognize a virtual sound source position in front of ad at a level higher than an actual position of the speaker portion" (col. 6, lines 18-27).

In deriving the correction curve shown in Figure 6B, Klayman specifically increases the high frequency component of the processed signal. However, this is not the only manner known in the art in which a difference between the levels of the low and high frequency components may be derived.

Klayman does not specify:

- a low pass filter for processing the low frequency component of a signal

- that the low pass filter has a cutoff frequency not lower than 2 KHz and not higher that 6 KHz

Grimini discloses a system for isolating and removing the low frequency component of an input signal referred to as a variable shelving network. Figure 5 illustrates one embodiment of such a system. As can be seen, the input signal is applied to two parallel paths, wherein the first path is connected directly to a summing network (66) (para. 0026). The other signal path comprises a a low pass filter and a variable gain amplifier (VGA). The VGA reads on "attenuator means for attenuating". The low pass filter (56) reads on "low pass filter means for reducing high frequency components". In the embodiment of Klayman that corresponds to Figure 6B, the cutoff of the high pass filter is 5 KHz (col. 15, lines 54-65). Applying this cutoff frequency to the converse signal processing means of Grimani reads on "a cutoff frequency of the low pass filter means is selected to be not lower than 2 KHz and not higher that 6 KHz".

To one of ordinary skill in the art at the time of the invention, it would have been obvious to utilize the variable shelving network of Grimani to establish a relative difference between the levels of the high and low frequency component of the signal being processed in the system of Klayman. The motivation behind such a modification would have been that such a processing scheme would have not increased the level of the high frequency component of an input signal in forming the different, split level correction signal. This would have afforded the overall signal level means of Klayman with a higher

resolution of the level of the high frequency component when utilizing the overall variable level resistance. This motivation is drawn from basic, well-known concepts in the relevant art of signal processing. The two approaches are also generally recognized as equivalent in the art.

However, Klayman in view of Grimani does not specify:

- that the involved summing means is a differential amplifier

Tokumo discloses a related system for correcting the audio signal reproduced in a vehicle. The system teaches several embodiments of correction circuits that include differential amplifiers. Figure 7 illustrates a high frequency correction circuit (10) centered around a differential amplifier (10) that provides an output based on the difference between an input signal and a signal partially comprising a the output signal (col. 5, lines 35-43). Figure 10 illustrates a similar circuit, which also utilizes differential amplifiers (col. 6, lines 3-15). These components, in view of their performed function, read on "differential amplifier means operative to produce a fourth audio signal corresponding to a difference between the first and third audio signals supplied thereto".

To one of ordinary skill in the art at the time the invention was made, it would have been obvious to substitute the differential amplifier means of Tokumo for the summing circuits of Klayman in view of Grimani. The motivation behind such a modification would have been that differential amplifiers are substantially art-recognized equivalents to other subtracting circuits, such as the combination of

an inverter and a summing circuit. The use of the negative terminal of the op amplifier eliminates the need for other components, such as an inverter.

However, Klayman in view of Grimani and Tokumo does not specify:

- that the attenuator means processes the input signal before it is applied to the low pass filter

However, the examiner takes Official Notice that both of this circuit arrangement is well known in the art. The order of the filter and attenuator of Klayman and Grimani is an art-recognized equivalent to an attenuator that provides an output signal to a low pass filter. This is because, in an ideal circuit, these two components do not affect the same characteristics of a processed signal; a low pass filter removes the amplitude of signals at certain frequencies and an attenuator alters the overall amplitude of the signal, irrespective of the frequencies included in the signal.

To one of ordinary skill in the art, it would have been obvious to utilize a differential amplifier and alter the order of the low pass filter and attenuator of the system of Klayman in view of Grimani and Tokumo, as is known in the prior art. Such changes would have been obvious because, as detailed above, these components and component arrangments are recognized equivalent to those shown in the system of Klayman in view of Grimini and Tokumo. It is further noted that Klayman teaches the use of one form of attenuating means that is positioned immediately before the filters in the input signal path.

Regarding **Claim 2**, Klayman teaches that the relative signal levels of the frequency component affect the perceived height or elevation of a signal source. Grimini discloses a VGA, the applied level of which is varied according to detected signal conditions (para. 0026). Klayman also discloses the use of a variable resistance for increasing or decreasing a respective signal level (col. 6, lines 18-31)). The variable aspect of these attenuators, in view of the teachings of Klayman, reads on "constituted with a variable attenuator by which the attenuation of the first audio signal is varied and said virtual sound source position is adjusted by changing the attenuation of the first audio signal".

Regarding **Claim 3**, the disclosed embodiment of Klayman includes separate improvement means for each of a left and right input signal (col. 14, lines 33-43). The variable resistors (252,296) read on "said attenuator means is provided for attenuating each of left and right channel signals forming a stereo audio signal" (col. 15, lines 7-13 and 65-67). The low pass filter of Grimani, in view of these two signal paths, reads on "low pass filter means is provided for reducing high frequency components of each of the attenuated left and right channel signals" (para. 0026). The summing amplifiers (306,324) of Klayman, in view of the differential amplifiers of Tokumo, read on "said differential amplifier means is provided to be operative to produce" a "left channel difference signal" and a "right channel difference signal" (col. 16, lines 49-51). The connections on Klayman of the Left Out and Right Out signals to the automobile speakers (46),

read on "speaker means is provided to include a left speaker supplied with the left channel difference signal" and "a right speaker supplied with the right channel difference signal" (col. 5, lines 54-61). The desired response curve, in view of the two arrows shown in the system of Figure 2 of Klayman that represent a pair of ideal speakers placed directly in front of a user at approximately ear level, reads on "attenuation of the left channel signal and attenuation of the right channel signal in the attenuator means are so selected that the listener is able to recognize a virtual left sound source position in front of and at a level higher than an actual position of the left speaker and recognize a virtual right sound source position in front of and at a level higher than an actual position of the right speaker" (col. 6, lines 24-27 and 32-37).

4. **Claims 4 and 5** are rejected under 35 U.S.C. 103 (a) as being unpatentable over Klayman in view of Grimani, Tokumo, and well-known prior art as applied above, and in further view of Kurisu (USPN 6108430).

As detailed above, Klayman discloses circuitry for the virtual positioning of a sound signal source. Grimani discloses an alternative embodiment for certain parts of such circuitry. Tokumo discloses the use of a differential amplifier in combining two signal to form and output. Well-known prior art teaches certain alternative arrangement for the circuitry of Klayman and Grimani.

However, Klayman in view of Grimani, Tokumo, and well known prior art does not specify:

- equations to be satisfied by the signal processing for two virtual left and right signals of:

$$SLO=(L\times ARR(z)-R\times ARL(z))/(ALL(z)\times ARR(z)-ALR(z)\times ARL(z))$$

$$SRO=(R\times ALL(z)-L\times ALR(z))/(ALL(z)\times ARR(z)-ALR(z)\times ARL(z))$$

$$L=SL\times BLL(z)+SR\times BRL(z)$$

$$R=SL\times BLR(z)+SR\times BRR(z)$$

wherein

SLO represents the amplified left channel difference signal,

SRO represents the amplified right channel difference signal,

SL represents the left channel signal,

SR represents the right channel signal,

ALL(z) represents an acoustic transfer function from the left speaker to a left ear of the listener,

ALR(z) represents an acoustic transfer function from the left speaker to a right ear of the listener,

ARL(z) represents an acoustic transfer function from the right speaker to the left ear of the listener,

ARR(z) represents an acoustic transfer function from the right speaker to the right ear of the listener,

BLL(z) represents an acoustic transfer function from the virtual left sound source position to the left ear of the listener,

BLR(z) represents an acoustic transfer function from the virtual left sound source position to the right ear of the listener,

BRL(z) represents an acoustic transfer function from the virtual right sound source position to the left ear of the listener, and

BRR(z) represents an acoustic transfer function from the virtual right sound source position to the right ear of the listener.

However, Kurisu teaches the equations for a general virtual sound source. Figure 2 illustrates a general arrangement of two real speakers (SP_L, SP_R) which output signal that form the virtual speaker (SP_x) (col. 4, lines 16-20). The shown equations are

HLL: transfer function starting from the sound source SPL and reaching the left ear of the listener M;
HLR: transfer function starting from the sound source SPL and reaching the right ear of the listener M;
HRL: transfer function starting from the sound source SPR and reaching the left ear of the listener M;
HRR: transfer function starting from the sound source SPR and reaching the right ear of the listener M;
HXL: transfer function starting from the sound source SPX and reaching the left ear of the listener M;
HXR: transfer function starting from the sound source SPX and reaching the right ear of the listener M;
the sound sources SPL and SPR can be expressed by

$$SPL\ (HXL \times HRR - HXR \times HRL)/(HLL \times HRR - HLR \times HRL) \times SPX \quad (1)$$

$$SPR\ (HXR \times HLL - HXL \times HLR)/(HLL \times HRR - HLR \times HRL) \times SPX \quad (2)$$

A correspondence can be seen between (ALL(z) and HLL), (ALR(z) and HLR), (ARL(z) and HRL), (ARR(z) and HRR), (BLL(z) and HXL), (BLR(z) and HXR), (BRL(z) and HXL), and (BRR(z) and HXR). Figure 2 only illustrates a single virtual speaker. The sound from two audio sources would inherently be the summation of the two transfer functions from the first source to the ears of a listener and from the second source to the ears of a listener. Accordingly, correspondence can also be seen between $(HXL \times HRR - HXR \times HRL)/(HLL \times HRR - HLR \times HRL)$ and

$SLO=(L \times ARR(z) - R \times ARL(z))/(ALL(z) \times ARR(z) - ALR(z) \times ARL(z))$

$L=SL \times BLL(z) + SR \times BRL(z)$
$R=SL \times BLR(z) + SR \times BRR(z)$

for just a left speaker a equals L=SL x BLL(z) and R=SL x BLR(z). Applied to the other

formula $SLO=(L\times ARR(z)-R\times ARL(z))/(ALL(z)\times ARR(z)-ALR(z)\times ARL(z))$, this formula becomes

$SLO=SL\times BLL(z)\times ARR(z)-SL\times BLR(z)\times ARL(z))/(ALL(z)\times ARR(z)-ALR(z)\times ARL(z))$, which can be rewritten as

$SLO=(SL)(BLL(z)\times ARR(z)-BLR(z)\times ARL(z))/(ALL(z)\times ARR(z)-ALR(z)\times ARL(z))$ which matches the formula given by Kurisu of $(HXL\times HRR-HXR\times HRL)/(HLL\times HRR-HLR\times HRL)\times SPX$, noting that the condition of SR=0 and SL=SPX was applied. Two virtual speakers are again, the addition of another copy of this equation for a second sound source. Thus, the descriptive formula taught by Kurisu reads on the equations given in Claim 4.

To one of ordinary skill in the art at the time the invention was made, it would have been obvious to utilize the equation of Kurisu on determining the operation of the postioning of the two ideal speakers of the system of Klayman in view of Grimani, Tokumo, and well known prior art. The motivation behind such a modification would have been that such an equation would have enabled the virtual positioning of the sound sources at an arbitrary location outside the head, and not just in front of a user. Figure 2 of Kurisu illustrates the positioning of a speaker behind a user.

Regarding **Claim 5**, Klayman teaches that the relative signal levels of the frequency component affect the perceived height or elevation of a signal source. Grimini discloses a VGA, the applied level of which is varied according to detected signal conditions (para. 0026). Klayman also discloses the use of a variable resistance for increasing or decreasing a respective signal level (col. 6, lines

18-31)). The variable aspect of these attenuators, in view of the teachings of Klayman, reads on "constituted with a variable attenuator by which the attenuation of the first audio signal is varied and said virtual sound source position is adjusted by changing the attenuation of the first audio signal". The left and right correction circuits of Klayman being paired with the left and right input signals, respectively, reads on "said virtual left sound source position is varied by changing the attenuation of the left channel signal and said virtual right sound source position is varied by changing the attenuation of the right channel signal".

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew Graham whose telephone number is 703-308-6729. The examiner can normally be reached on Monday-Friday, 8:30 AM to 5:00 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Isen can be reached on (703)305-4386. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AG

Andrew Graham
Examiner
A.U. 2644

ag
June 28, 2004

MINSUN OH HARVEY
PRIMARY EXAMINER